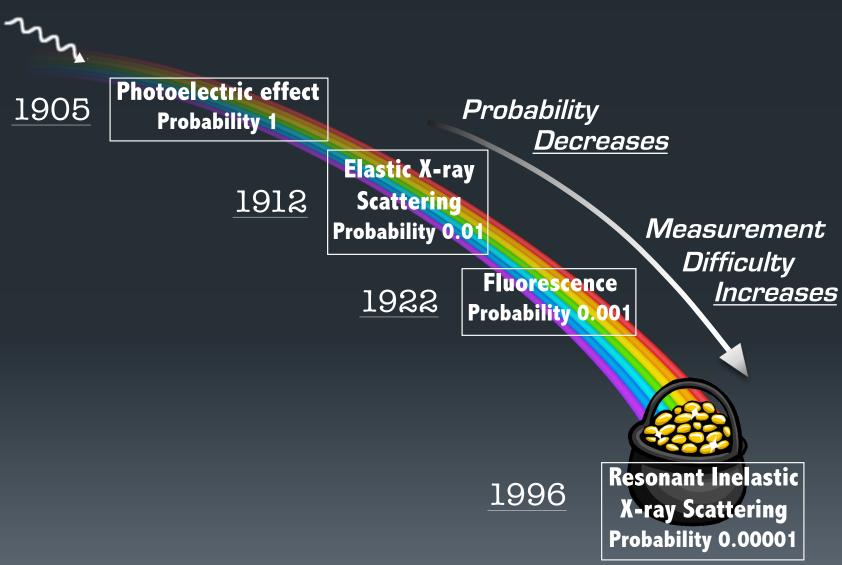


Ignace Jarrige, NSLS-II
MIT BNL Workshop – July 26 2017

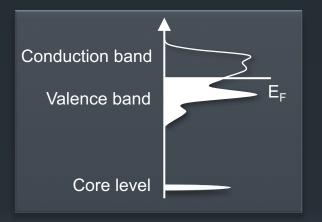
### X-rays Meet Matter



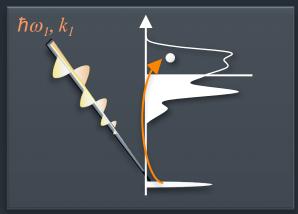
### The RIXS Process

#### Three-Step Process: Lower Probability but Richer Information on Electrons

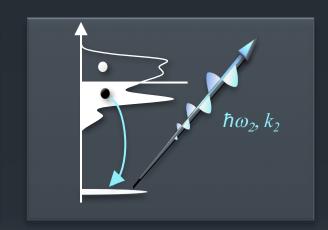
Initial State



Intermediate State



Final State



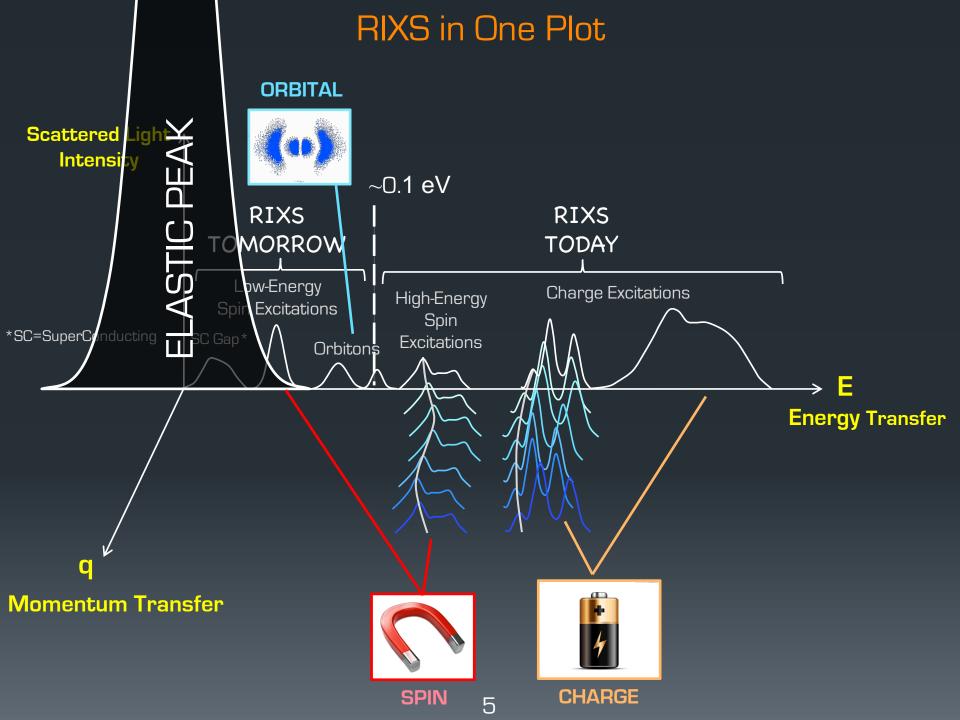
#### RIXS measures:

 $\Delta E = E_1 - E_2$  $\Delta q = k_1 - k_2$ 

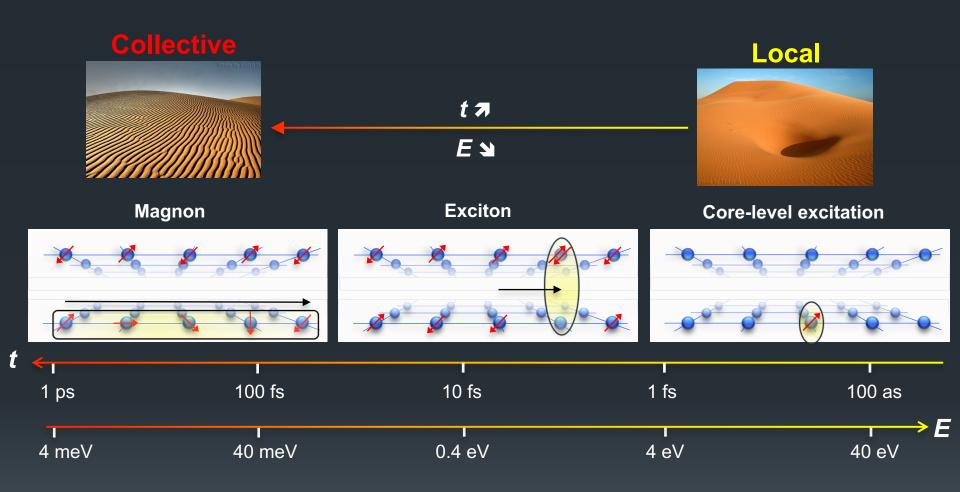
#### RIXS in a Few Words

- Sensitive to different degrees of freedom (lattice, charge, spin, orbital)
- Probes both occupied and unoccupied states
- Element selective, orbital selective
- Bulk sensitive

• Compatible with realistic sample environments



### RIXS in the Time Domain



Unveiling long-lived (low-energy) collective excitations requires high energy resolution

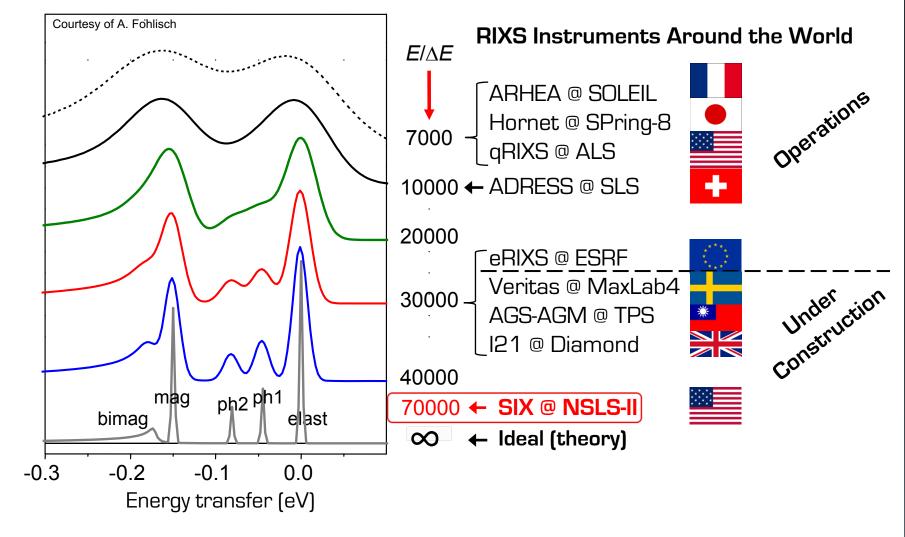
### The SIX Beamline in One Number

A Combined Beamline / Spectrometer Resolving Power Of

70,000

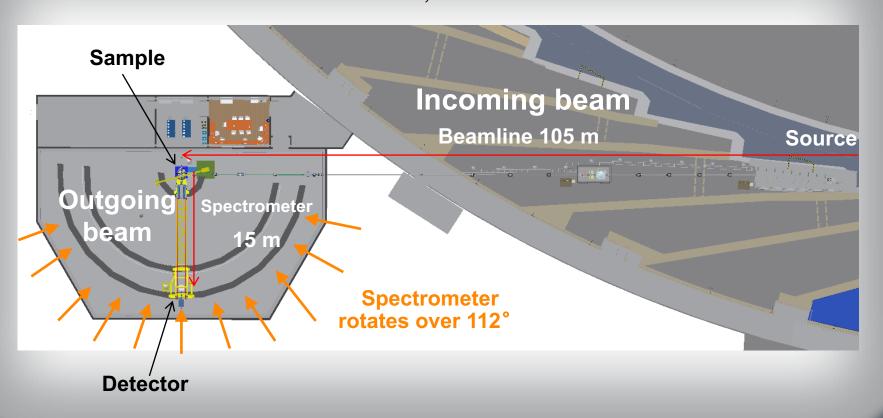
#### World-wide resolution race of RIXS

# RIXS Spectrum Shown for Different Energy Resolutions

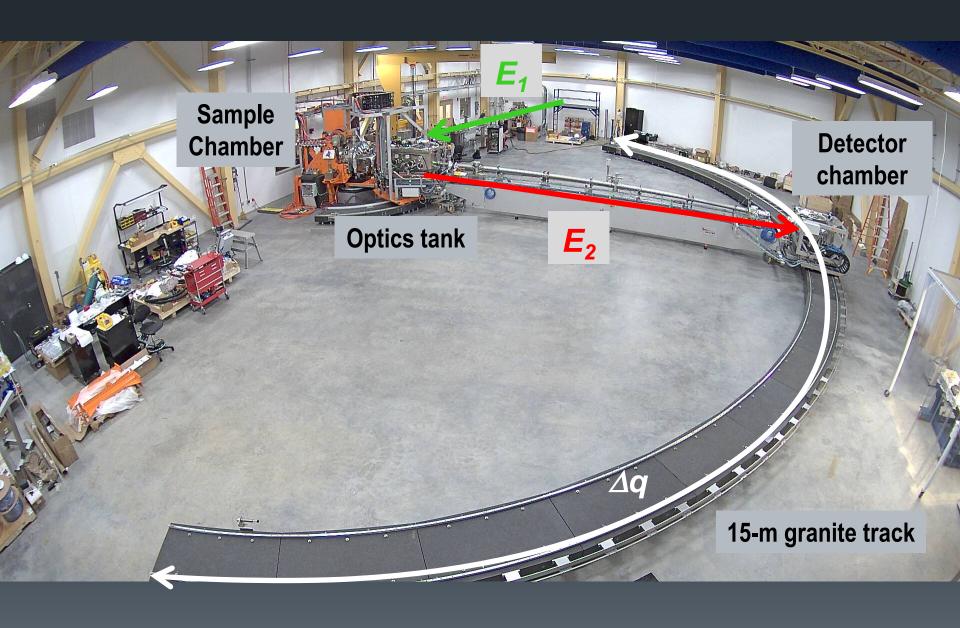


## SIX Needs to be Long

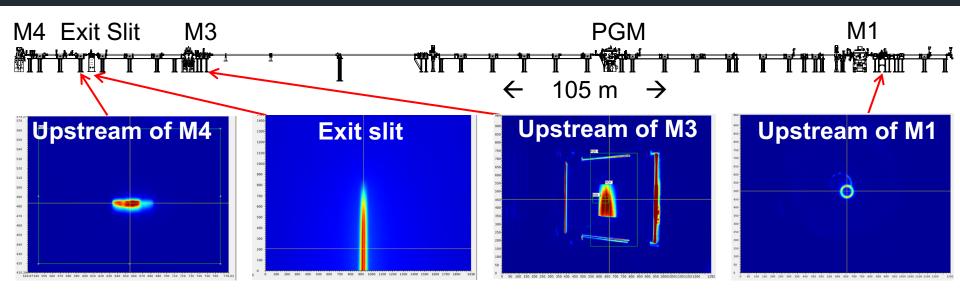
SIX, NSLS-II

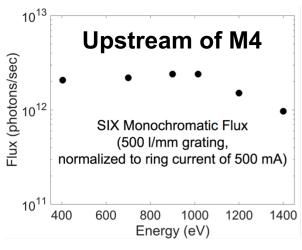


## The SIX spectrometer



### First Light of SIX February 21, 2017

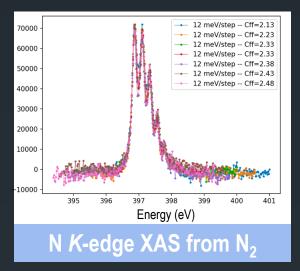




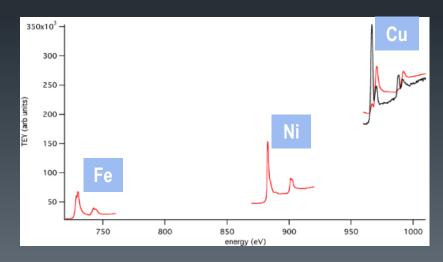


### Beamline Performance So Far

Calibration of monochromator nearly complete. N K-edge XAS measurements
performed on N<sub>2</sub> gas cell to determine optimal value of c<sub>ff</sub>.



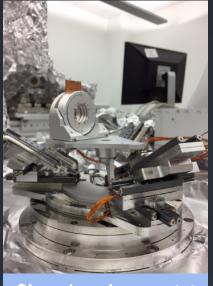
• XANES spectra can now be routinely measured:



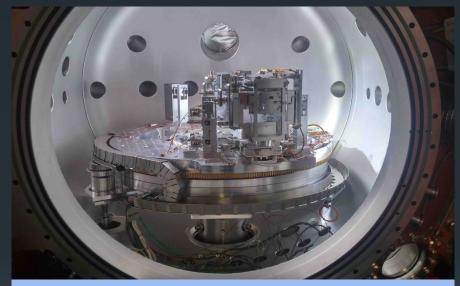
# Sample Environment



sample holder



Closed-cycle cryostat and in-vacuum diffractometer

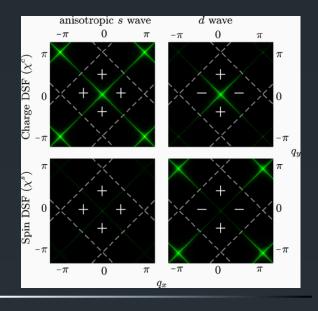


Optics wheel around sample with photodiodes

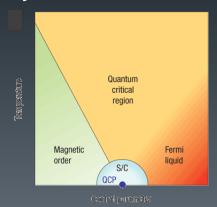
## Science at SIX

RIXS Investigations of Quantum Materials with Ultrahigh Energy Resolution

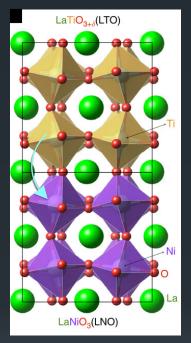
#### Phase and Amplitude of Superconducting Gap



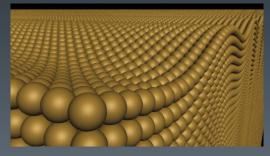
#### **Heavy Fermion Quantum Criticality**



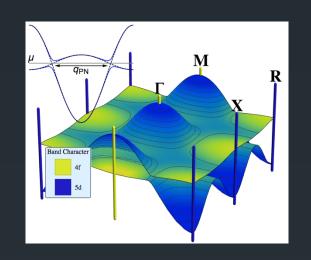
# Ultrathin Films and Heterostructures



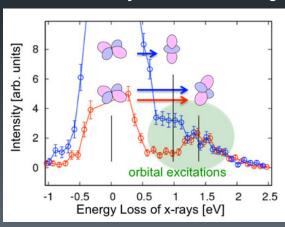
#### **Electron-Phonon Coupling**



#### Topological phases of f electron systems



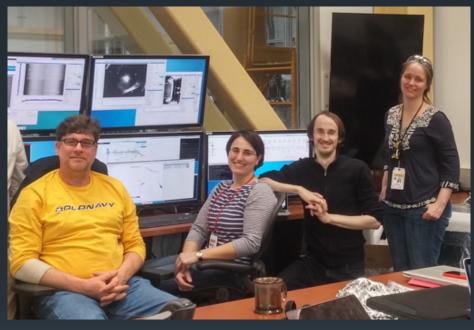
**Polarization Analysis of Scattered Light** 



# When is this Science Starting?

First Science Commissioning Users
Expected
Early 2018

# The SIX Team



Joe Dvorak Valentina Bisogni

Ignace Jarrige Andi Barbour

Thank you for your attention